A STUDY ON ROLE OF INTRAMEDULLARY INTERLOCKING NAILING IN THE COMPLEX FEMORAL SHAFT FRACCTURES – SHORT TERM OUTCOME ANALYSIS

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CERTIFICATE

This is to certify that this dissertation entitled **"A STUDY ON ROLE OF INTRAMEDULLARY INTERLOCKING NAILING IN THE COMPLEX FEMORAL SHAFT FRACTURES - SHORT TERM OUTCOME ANALYSIS"** *submitted by* ***Dr. S.P.Ilangovan*** *appearing for Part II, M.S. Branch II – Orthopaedic Surgery degree examination in March 2009 is a bonafide record of work done by him under my direct guidance and supervision in partial fulfillment of regulations of The Tamil Nadu Dr.M.G.R. Medical University, Chennai.*

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CONTENTS

INTRODUCTION

Fractures of the shaft of femur are a major cause of morbidity and mortality in patients who sustain high energy trauma. Morbidity arises from limb shortening, mal alignment, knee contractures and other complications of fracture. Mortality is infrequent but can result from an open wound, fat embolism, adult respiratory distress syndrome or multiple organ failure especially in the polytrauma patients. Both morbidity and mortality can be diminished by prompt reduction and internal fixation of the fracture.(Robert A.,HansenT.et al. 1978.)[1].

Restoration of alignment, rotation and length, preservation of the blood supply to aid union and rehabilitation of the patient is the goal of treatment. The type and location of the fracture, degree of comminution, the age of the patient, patients social, economic demands and other associated fractures may influence the method of treatment.

Currently intramedullary, interlocking nailing is considered to be the treatment of choice for complex femoral shaft fractures.(Funk .J.,Wells.R et al 1968.)[2]

AIM

The aim of our study is to analysis the results of complex femoral shaft fractures treated by intramedullary interlocking nailing in our institution.

REVIEW OF LITERATURE

Intramedullary fixation of fractures of long bones is one of the modes of treatment since 16th century. Wooden Pegs, Ivory Pegs were used as intramedullary devices followed by metals. Early, orthopaedic surgeons Koning, Hoagland, Lembotte, Heygroves investigated the use of ivory, bone and metal as intramedullary devices.

Successful intramedullary nailing began during World War II with the work of Kuntscher. Kuntscher and Naatz (1994) described intramedullary nailing for femur along with other bones like tibia, humerus, radius and ulna. In early 1950 Livingstone and Modny came out with intramedullary devices with slots all along their length for cross pinning with screws. In 1957, Kuntscher recommended reaming to achieve a uniform diameter for medullary canal and better fixation, extending the indications for intramedullary nailing for fractures, a little away from the isthmus.(Kuntscher, Aerhand et al. 1967.)[3]

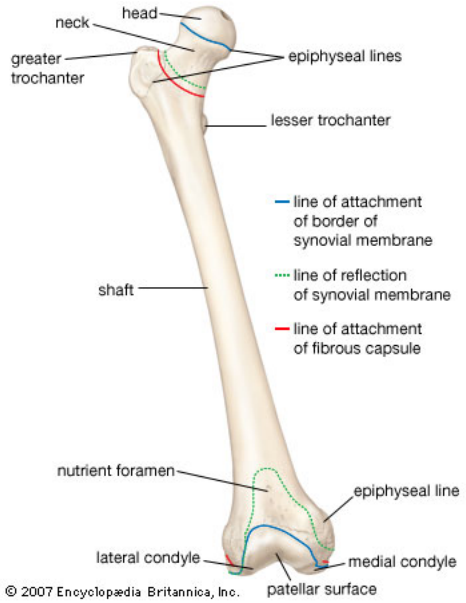
Kaesimann contributed the concept of compression nailing in 1966. The distal fragment was anchored to the nail through cross pins and fracture fragments compressed with a device called the

detensor nail for comminuted fractures for achieving stability with transverse bolts, through prefabricated holes in the nail. This started the era of interlocking nailing.

J. Ender introduced the use of multiple pre-bend flexible pins in 1970. In the early 1970 fluted intramedullary rods come into existence, it was designed for better torsional stability. In 1972 Klemm & Schellmann developed instrumentation and standardrized the operative techniques(Klem K.W., Boren M.et al)[4]. In 1972, Grosse & Kempt in Strasbourg, France developed G.K. Nail for both femur and tibia and broadened the indications.

ANATOMY OF FEMUR

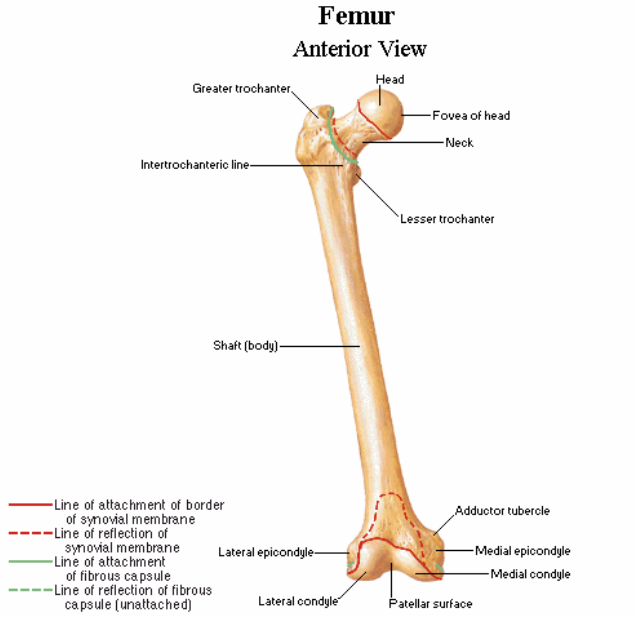
The femur or thigh bone is the longest and the strongest bone of the body. Like any other long bone it has two ends upper and lower, and a shaft.



ANATOMICAL POSITION

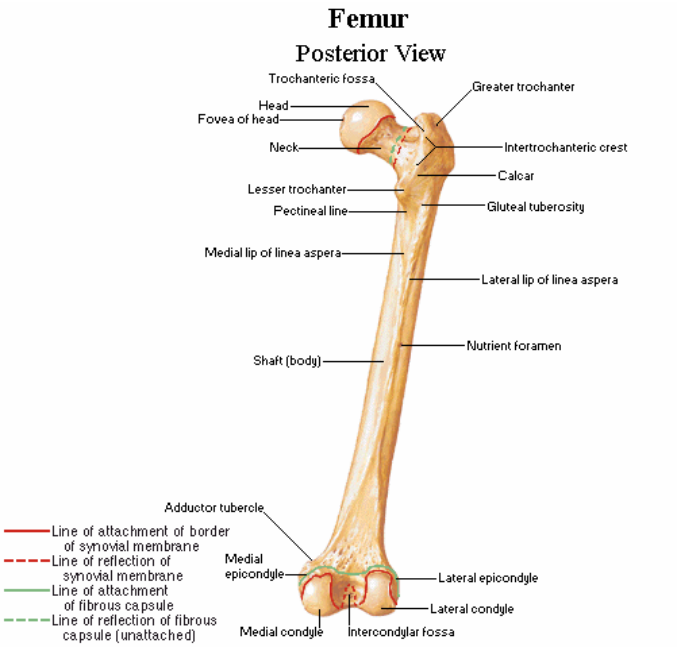
1. The head is directed medially upwards and slightly forwards.

2. The shaft is directed obliquely downwards and medially so that the lower surfaces of the two condyles of the femur lie in the same horizontal plane.



UPPER END

The upper end of the femur includes the head, the neck, the greater trochanter, the lesser trochanter, the intertrochanteric line, and the intertrochanteric crest. These are described as follows.



HEAD

1. The head forms more than half a sphere, and is directed medially, upwards and slightly forwards .
2. It articulates with the acetabulum to form the hip joint.
3. A roughened pit is situated just below and behind the centre of the head. This pit is called the fovea.

NECK

1. It connects the head with the shaft and is about 3.7 cm long.
2. It makes an angle with the shaft. The neck- shaft angle is about 125° in adults. It is less in females due to their wider pelvis. The angle facilitates movements of the hip joint. It is strengthened by a thickening of bone called the calcar fermorale present along its concavity.

GREATER TROCHANTER

1. This is large quadrangular prominence located at the upper part of the junction of the neck with the shaft. The upper border of the trochanter lies at the level of the centre of the head.

LESSER TROCHANTER

Is a conical eminence directed medially and backwards from the junction of the posteroinferior part of the neck with the shaft.

SHAFT

The shaft is more or less cylindrical. It is narrowest in the middle, and is more expanded inferiorly than superiorly. It is convex forwards and is directed obliquely downwards and medially, because the upper ends of two femora are separated by the width the pelvis, and their lower ends are close together. In the middle one-third, the shaft has three borders, medial, lateral and posterior and three surfaces, anterior, medial and lateral. The medial and lateral borders are rounded and ill-defined, but the posterior border is in the form of a broad roughened ridge, called the linea aspera. The medial and lateral surfaces directed more backwards than towards the sides.

In the upper one-third of the shaft, the two lips of the linea aspera diverge to enclose an additional posterior surface. Thus it has four borders, medial, lateral, spiral line and the lateral lip of the gluteal tuberosity and four surfaces anterior, medial, laleral and posterior. The gluteal tuberosity is a broad roughened ridge on the lateral part of the posterior surface.

In the lower one-third of the shaft also, the two lips of the linea aspera diverge as supracondylar lines to-enclose an additional, popliteal surface. Thus, this part of the shaft has four borders, medial, lateral, medial supracondylar line and lateral supracondylar line and four surfaces, anterior, medial, lateral and popliteal. The medial border and medial supracondylar line meet inferiorly to obliterate the medial surface.

LOWER END

The lower end of the femur is widely expanded to form two large condyles, one medial and one lateral. Anteriorly, the two condyles are united and are in line with the front of the shaft. Posteriorly, they are separated by a deep gap, termed the intercondylar fossa or intercondylar notch, and project backwards much beyond the plane of the popliteal surface.

ATTACHMENTS OF THE FEMUR

1. The fovea on the head of the femur provides attachment to the ligament of the head of femur or ligamentum teres .

2. The following are attached to the greater trochanter.

   a. The piriformis is inserted into the apex.

b. The gluteus minimus is inserted into the rough lateral part of the anterior surface .

c. The obturator internus and the two gemelli are inserted into the upper rough impression on the medial surface .

d. The obturator externus is inserted into the trochanteric fossa.

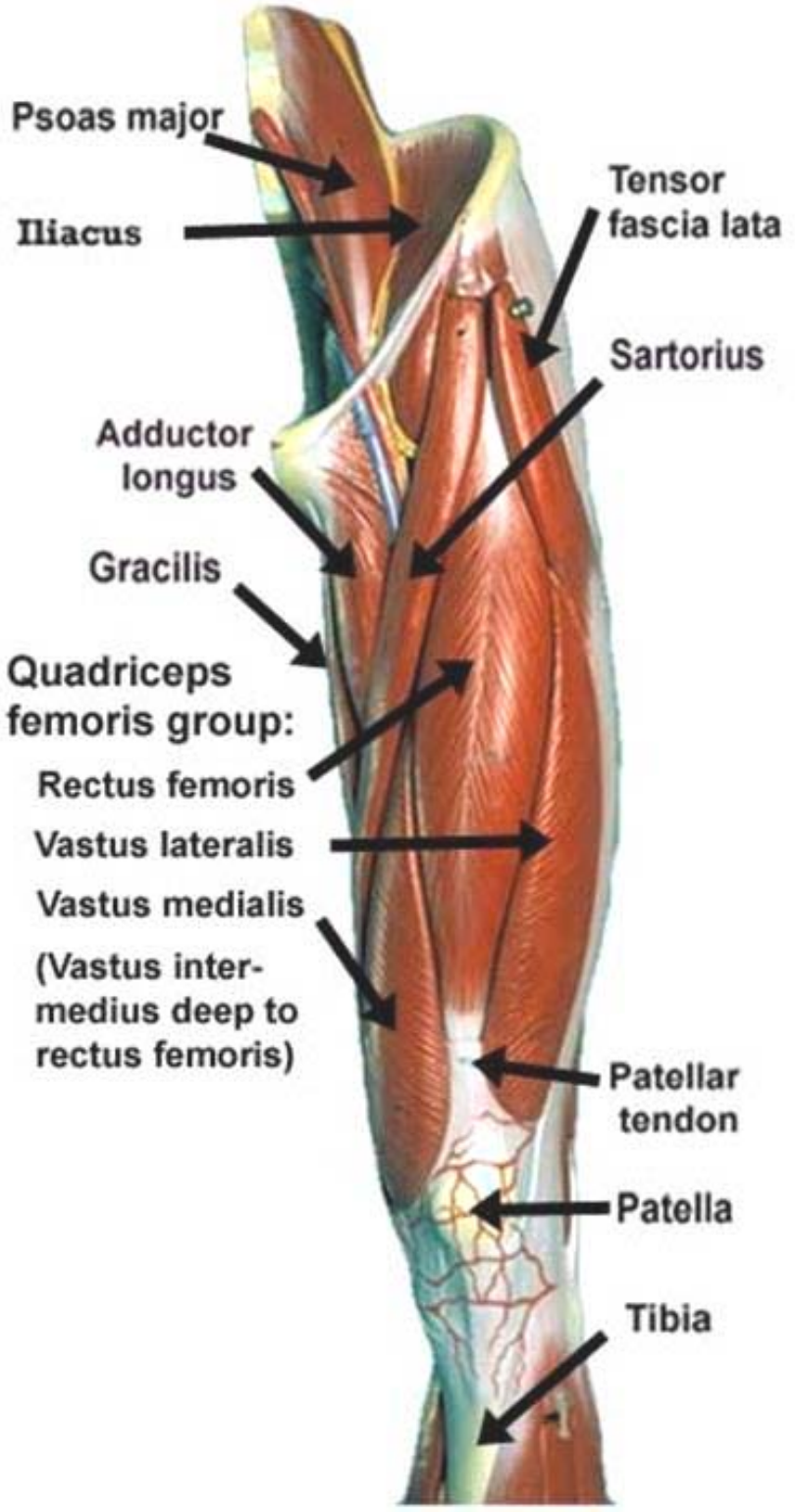
e. The gluteus medius is inserted into the ridge on the lateral surface. The trochanteric bursa of the gluteus medius lies in front of the ridge, and the trochanteric bursa of the gluteus maximum lies behind the ridge .

3. The attachments on the lesser trochanter are as follows.

a. The psoas major is inserted on the apex and medial part of the rough anterior surface .

b. The illacus is inserted on the anterior surface of the base of the trochanter and on the area below it.

c. The smooth posterior surface of the lesser trochanter is covered by a bursa that lies deep to the upper horizontal fibres of the adductor magnus.


Psoas major
Iliacus
Tensor fascia lata
Sartorius
Adductor longus
Gracilis
Quadriceps femoris group:
Rectus femoris
Vastus lateralis
Vastus medialis
(Vastus inter-medius deep to rectus femoris)
Patellar tendon
Patella
Tibia

4. The intertrochanteric line provides: a) Attachment to the capsular ligament of the hip joint; (b) attachment to the upper band of the iliofemoral ligament in its upper part; (c) attachment to the lower band of the iliofemoral ligament in its lower part. (d) origin to the highest fibres of the vastus lateralis from the upper end; and (e) origin to the highest fibres of the vastus medialis from the lower end of the line.

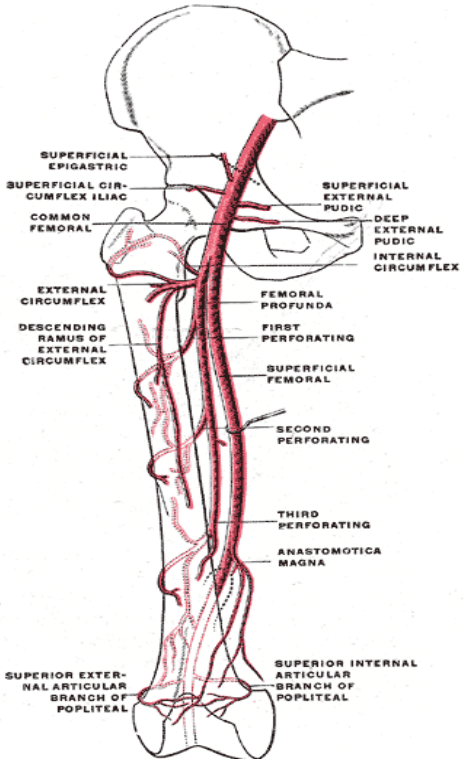
5. The quadrate tubercle receives the insertion of the quadratus femoris.

6. The attachments on the shaft are as follows.

    a. The medial and popliteal surfaces are bare, except for a little extension of the origin of the medial head of the gastronemius to the popliteal surface. The vastus intermedius arises from the upper three-fourths of the anterior and lateral surfaces. (c) The articularis genu arises just below the vastus intermedius. (d) The lower 5 cm of the anterior surface are related to suprapatellar bursa. (e) The vastus lateralis arises from the upper part of the intertrochanteric line, anterior and inferior borders of the greater trochanter, the lateral lip of the gluteal tuberosity, and the upper half of the lateral lip of the linea aspera.

(f).The vastus medialis arises from the lower part of the lntertrochanteric line, the spiral line, the medial lip of the linea aspera, and the upper one-fourth of the medial supracondylar line. (g) The deeper fibres of the lower half of the gluteus maximus are inserted into the gluteal tuberosity. (h) The adductor longus is inserted along the medial lip of the linea aspera between the vastus medialis and the adductors brevis and magnus (I) The adductor brevis is inserted into a line extending from the lesser trochanter to the upper part of the linea aspera, behind the pectineus and the upper part of the adductor longus. (j) The adductor magnus is inserted into the medial margin of the gluteal tuberosity, the linea aspera. the medial supracondylar line, and the adductor tubercle, leaving a gap for the popliteal vessels. (k) The pectineus is inserted on a line extending from the lesser trochanter to the linea aspera. (l) The short head of the biceps tendons arises from the lateral lip of the linea aspera between the vastus lateralis and the adductor magnus, and from the upper two-thirds of the lateral supracondylar line. (m) The medial and lateral intermuscular septa are attached to the lips of the linea aspera and to the supracondylar lines. They separate

the extensor muscles from the adductors medially, and from the flexors laterally. (n) The lower end of the lateral supracondylar line gives origin to the plantaris above and the upper part of the lateral head of the gastronemius below. (o) The. popliteal surface is covered with fat and forms the floor of the popliteal fossa. The origin of the medial head of the gastronemius extends to the popliteal surface just above the medial condyle.



Blood supply of femur

NUTRIENT ARTERY TO THE FEMUR

Femur is supplied by femoral artery.The nutrient artery is derived from the second perforating artery. In case it is absent, it is replaced by two nutrient arteries derived from the first and third perforating arteries. The nutrient foramen is located on the medial side of the linea aspera, and is directed upwards.(B.D Chaurasia)[4]

FRACTURE SHAFT OF FEMUR

MECHANISM OF INJURY

- Femoral shaft fractures in adults are almost always the result of high-energy trauma. These fractures result from motor vehicle accident, gunshot injury; or fall from a height.

- Pathologic fractures, especially in the elderly, commonly occur at the relatively weak metaphyseal-diaphyseal junction. Any fracture that is inconsistent with the degree of trauma should arouse suspicion for pathological fracture.

- Stress fractures occur mainly in military recruits or runners. Most patients report a recent increase in training intensity just before the onset of thigh pain.

CLINICAL EVALUATION

- Because these fractures tend to be the result of high-energy trauma, a full trauma survey is indicated.

- The diagnosis of femoral shaft fracture is usually obvious, with the patient presenting nonambulatory with pain, variable gross deformity, swelling, and shortening of the affected extremity.

- A careful neurovascular examination is essential, although neurovascular injury is uncommonly associated with femoral shaft fractures.

- Thorough examination of the ipsilateral hip and knee should be performed, including systematic inspection and palpation. Range-of-motion or ligamentous testing is often not feasible in the setting of a femoral shaft fracture and may result in displacement. Knee ligament injuries are common, however, and need to be assessed after fracture fixation.

- Major blood loss into the thigh may occur. The average blood loss in one series was greater than 1200 mL, and 40% of patients ultimately required transfusions. Therefore, a careful preoperative assessment of hemodynamic stability is essential, regardless of the presence or absence of associated injuries.

ASSOCIATED INJURIES

- Associated injuries are common and may be present in up to 5% to 15% of cases, with patients presenting with multisystem trauma, spine, pelvis, and ipsilateral lower extremity injuries.

- Ligamentous and meniscal injuries of the ipsilateral knee are present in 50% of patients with closed femoral shaft fractures.

RADIOGRAPHIC EVALUATION

- Anteroposterior (AP) and lateral views of the femur, hip, and knee as well as an AP view of the pelvis should be obtained.
- The radiographs should be critically evaluated to determine the fracture pattern, the bone quality, the presence of bone loss, associated comminution, the presence of air in the soft tissues, and the amount of fracture shortening.
- One must evaluate the region of the proximal femur for evidence of an associated femoral neck or intertrochanteric fracture.
- If a computed tomography scan of the abdomen and pelvis is obtained for other reasons, this should be reviewed because it may provide evidence of injury to the ipsilateral acetabulum or femoral neck.

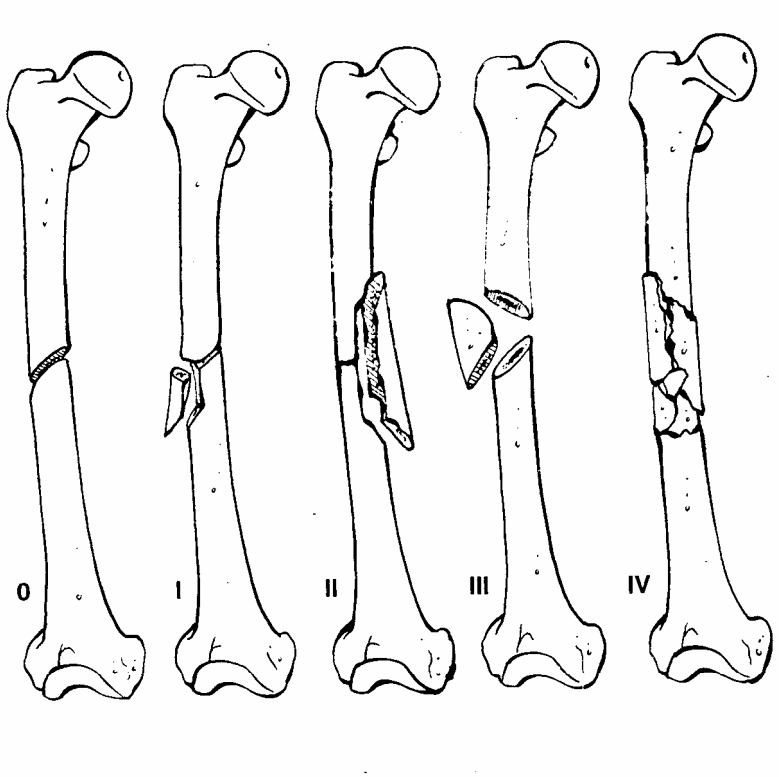
CLASSIFICATION

DESCRIPTIVE

- Open versus closed injury
- Location: proximal, middle, or distal one-third
- Location: isthmal, infraisthmal or supracondylar

- Pattern: spiral, oblique, or transverse
- Comminuted, segmental, or butterfly fragment
- Angulation or rotational deformity
- Displacement: shortening or translation

WINQUIST AND HANSEN



- This is based on fracture comminution.
- It was used before routine placement of statically locked intramedullary nails.

Type 0 : no comminution

Type I : Minimal comminution

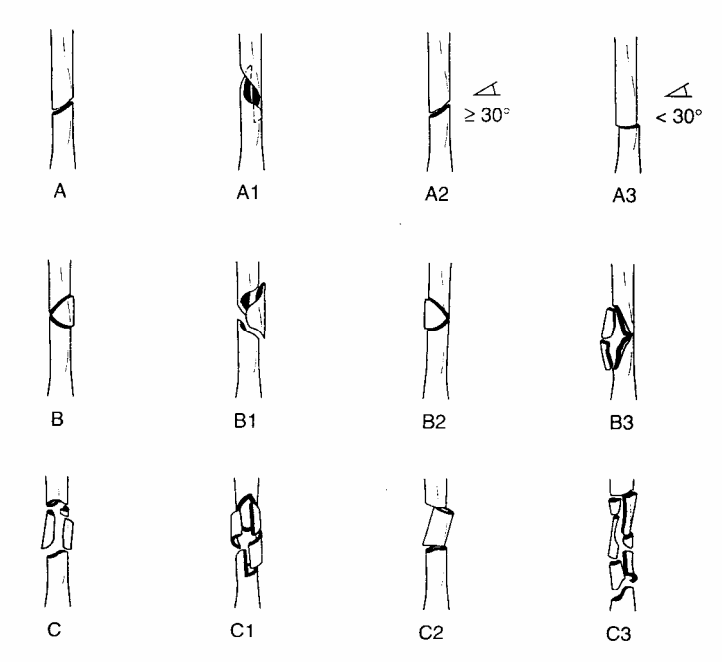
Type II : Cortices of both fragments at least 50% intact

Type III : 50% to 100% cortical comminution

Type IV : Circumferential comminution with no cortical contact.(Barei. DP,Butler M.S et al 2003.)[6,7]

A.O CLASSIFICATION

It is largely based on the fracture morphology, fracture location as well as degree and type of comminution.



1.Type A-simple fracture .(spiral, oblique,transverse).

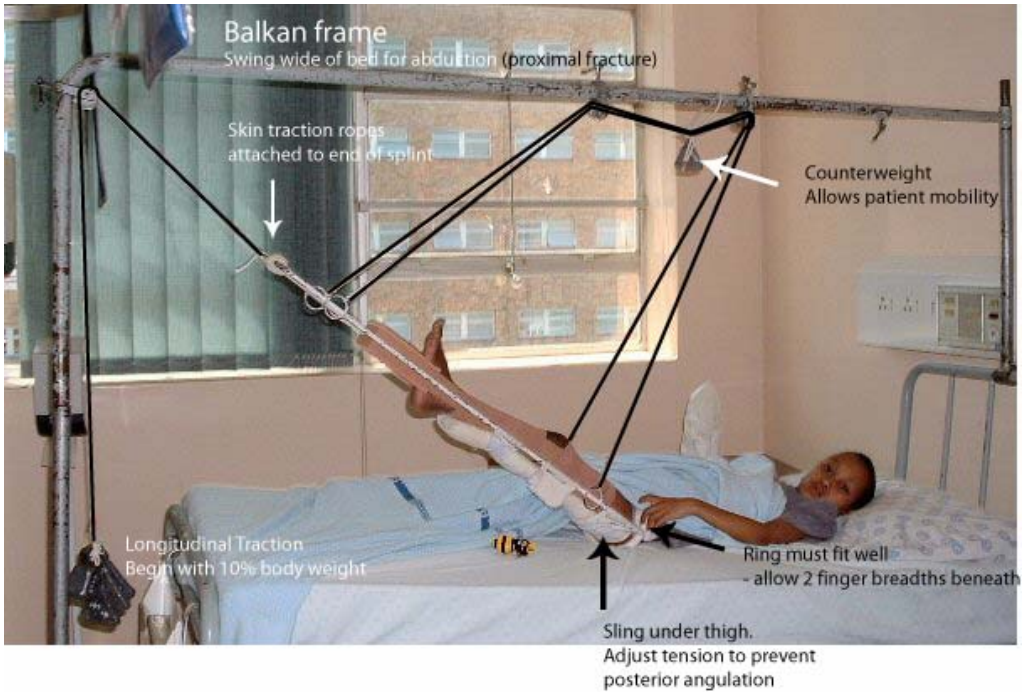
2. Type B-Wedge fracture (spiral,bending, segmental)

3.Type C-Complex fracture(spiral, segmental, irregular)

TREATMENT

NONOPERATIVE

Skeletal traction



- Currently, closed management as definitive treatment for femoral shaft fractures is largely limited to adult patients with such significant medical comorbidities that operative management is contraindicated.

- The goal of skeletal traction is to restore femoral length, limit rotational and angular deformities, reduce painful spasms, and minimize blood loss.

- Skeletal traction is usually used as a temporary measure before surgery to stabilize the fracture and prevent fracture shortening.

- 20 to 40 lb of traction is usually applied and a lateral radiograph checked to assess fracture length.

- Distal femoral pins should be placed in an extracapsular location to avoid the possibility of septic arthritis. Proximal tibia pins are typically positioned at the level of the tibial tubercle and are placed in a bicortical location.

- Safe pin placement is usually from medial to lateral at the distal femur (directed away from the femoral artery) and from lateral to medial at the proximal tibia (directed away from the peroneal nerve).

- Problems with use of skeletal traction for definitive fracture treatment include knee stiffness, limb shortening, prolonged hospitalization, respiratory and skin ailments, and malunion.

- Definitive treatment of femoral shaft fractures has been successfully accomplished by Neufeld roller traction . The main advantage with Neufeld traction are early knee motion,enhanced patient mobility and early discharge from the hospital.(Mays J.,Neufild A.J 1974.)[8]

CAST BRACES:-

Similar to traction techniques, cast braces are now used uncommonly for the treatment of femoral shaft fractures.In unusual circumstances, they used to augment intramedullary fixation if unlocked implant used.(Sharma JC., Gupta S.P et al 1993.)[9.] for distal femoral shaft fractures. Cast braces allow early patient mobilization and may be used in combination with traction (Connoly J.F.,Dehne E et al 1973.)[10]. Cast braces work by converting thigh into a semi rigid hydraulic tube that maintain the alignment of the femur. (Mooney V., Nickel V.L.et al 1970.)[11]

OPERATIVE

- Operative stabilization is the standard of care for most femoral shaft fractures.

- Surgical stabilization should be done within 24 hours, if possible.

- Early stabilization of long bone injuries appears to be particularly important in the poly trauma patient.

INTRAMEDUALLY (IM) NAILING

- This is the standard of care for femoral shaft fractures.(Martinus B., Terje T.et al 1993.)[12]

- Its intramedullary location results in lower tensile and shear stresses on the implant than plate fixation. Benefits of intramedullary nailing over plate fixation include less extensive exposure and dissection, lower infection rate, and less quadriceps scarring.(Robert A., Hansen T et al 1978) [1] . Nailing in closed fractures has the advantage of maintaining both the fracture hematoma and the attached periosteum. If reaming is performed, these elements provide a combination of osteoinductive and osteoconductive materials to the site of the fracture.(H.C Pape, P.Giannoudis et al 2007).[13]

- Other advantages include early functional use of the extremity, restoration of length and alignment with comminuted fractures, rapid and high union (>95%), low refracture rates.Good

stability and early consolidation of fracture are both advantageous in obtaining good function of the knee.(B.O .Thoresen, A Alho et al 1985 .)[14]

ANTEGRADE INSERTED INTRAMEDULLARY (IM) NAILING

- Surgery can be performed on a fracture table or on a radiolucent table with or without skeletal traction.

- The patient can be positioned supine or lateral. Supine positioning allows unencumbered access to the entire patient. Lateral positioning facilitates identification of the piriform fossa starting point but may be contraindicated in the presence of pulmonary compromise.

- One can use either a piriformis fossa or greater trochanteric starting point. The advantage of a piriformis starting point is that it is in line with the medullary canal of the femur. However, it is easier to locate the greater trochanteric starting point. Placement of the entrance hole is critical for a successful closed nailing.Tip of the awl should be in line with the longitutional axis of the medullary canal in both the AP and mediolateral planes.A more anterior placement of the entrance hole can result in inadvertent perforation of the anterior cortex.

With the currently available nails, the placement of large diameter nails with an intimate fit along a long length of the medullary canal is no longer necessary. The role of unreamed intramedullary nailing for the treatment of femoral shaft fractures remains unclear. The potentially negative effects of reaming for insertion of intramedullary nails include elevated intramedullary pressures, elevated pulmonary artery pressures, increased risk of fat embolism, and pulmonary dysfunction. The potential advantages of reaming rate include the ability to place a larger implant, increased union, and decreased hardware failure.(H.C Pape P., Grannoudis et al 2007)[13].

- All Intramedullary nails should be statically locked to maintain femoral length and control rotation. The number of distal interlocking screws necessary to maintain the proper length, alignment, and rotation of the implant bone construct depends on numerous factors including fracture comminution, fracture location, implant size, patient size, bone quality, and patient activity.

RETROGRADE INSERTED INTRAMEDULLARY NAILING

- The major advantage with a retrograde entry portal is the ease in properly identifying the starting point.

- Relative indications include:
    - Ipsilateral injuries such as femoral neck, trochanteric, acetabular, patellar, or tibial shaft fractures.
    - Bilateral femoral shaft fractures.
    - Morbidly obese patient.
    - Pregnant woman.
    - Periprosthetic fracture above a total knee arthroplasty.
    - Ipsilateral through knee amputation in a patient with an associated femoral shaft fracture.

EXTERNAL FIXATION;

- Use as definitive treatment for femoral shaft fractures has limited indications.
- Its use is most often provisional.
- Advantages include the following:
    - The procedure is rapid; A temporary external fixator can be applied in less than 30 minutes.

  - The vascular supply to the femur is minimally damaged during application.
  - No additional foreign material is introduced in the region of the fracture.
  - It allows access to the medullary canal and the surrounding tissues in open fractures with significant contamination.(Alonso J., Geisser W. et al 1989.)[15]

- Disadvantages: Most are related to use of this technique as a definitive treatment and include:
  - Pin tract infection.
  - Loss of knee motion.
  - Angular malunion and femoral shortening.
  - Limited ability to adequately stabilize the femoral shaft.
  - Potential infection risk associated with conversion to an intramedullary nail.

- Indications for use of external fixation include:

- Use as a temporary bridge to intramedullary nailing in the severely injured patient.
- Ipsilateral arterial injury that requires repair
- Patients with severe soft tissue contamination in whom a second debridement would be limited by other devices.(TurenCH.,Brumback RJ et al 2000.)[16.]

PLATE FIXATION

Plate fixation for femoral shaft stabilization has decreased with the use of intramedullary nails.

- Advantages to plating include:
  - Ability to obtain an anatomic reduction in appropriate fracture patterns.
  - Lack of additional trauma to remote locations such as the femoral neck, the acetabulum, and the distal femur.
- Disadvantages compared with intramedullary nailing include:
  - Need for an extensive surgical approach with its associated blood loss, risk of infection, and soft

tissue insult. This can result in quadriceps scarring and its effects on knee motion and quadriceps strength.

- Decreased vascularization beneath the plate and the stress shielding of the bone spanned by the plate.
- The plate is a load bearing implant; therefore, higher rate of implant failure.(Robert S, Ganz R et al. 1998.)[17]

- Indications include:
  - Extremely narrow medullary canal where intramedullary nailing is impossible or difficult.
  - Fractures that occur adjacent to or through a previous malunion.
  - Obliteration of the medullary canal due to infection or previous closed management.
  - Fractures that have associated proximal or distal extension into the pertrochanteric or condylar regions.

- In patients with an associated vascular injury the exposure for the vascular repair frequently involves a wide exposure of the medial femur. If rapid femoral stabilization is desired, a plate can be applied quickly through the medial open exposure.(Gates DJ .,Alms M. et al. 1985.)[18]

- An open or a submuscular technique may be applicable.

- As the fracture comminution increases, so should the plate length such that at least four to five screw holes of plate length are present on each side of the fracture.

- The routine use of cancellous bone grafting in plated femoral shaft fractures is questionable if indirect reduction techniques are used.

FEMUR FRACTURE IN POLY TRAUMA PATIENT

- The impact of femoral nailing and reaming is controversial in the polytrauma patient.

- In a specific subpopulation of patients with multiple injuries, early intramedullary nailing is associated with elevation of certain proinflammatory markers.

- It has been recommended that early external fixation of long bone fractures followed by delayed intramedullary nailing may minimize the additional surgical impact in patients at high risk for developing complications.

IPSILATERAL FRACTURES OF THE PROXIMAL OR DISTAL FEMUR

- Concomitant femoral neck fractures occur in 3% to 10% of patients with femoral shaft fractures. Options for operative fixation include antegrade intramedullary nailing with multiple screw fixation of the femoral neck, retrograde femoral nailing with multiple screw fixation of the femoral neck, and compression plating with screw fixation of the femoral neck. The sequence of surgical stabilization is controversial.

- Ipsilateral fractures of the distal femur may exist as a distal extension of the shaft fracture or as a distinct fracture. Options for fixation include fixation of both fractures with a single plate, fixation of the shaft and distal femoral fractures with separate plates, IM nailing of the shaft fracture with plate fixation of the distal femoral fracture, or interlocked IM nailing spanning both fractures (high supracondylar fractures).

OPEN FEMORAL SHAFT FRACTURES

- These are typically the result of high-energy trauma.
- Patients frequently have multiple other orthopaedic injuries and involvement of several organ systems.
- Treatment is emergency debridement with skeletal stabilization.

MATERIAL &METHODS

Between the oct 2006-nov2008., 20 cases of complex femoral fractures were treated with intramedullary interlocking in govt general hospital were included in our study.19 patients were male and one was female.Age group of these patients were ranging from 18-78 years.

INCLUSION CRITERIA

complex femoral fractures in adults

EXCLUSION CRITERIA

All Compound fractures.

All Fractures in the paediatric and adolescent age group.

Associated head injury, visceral injuries.

Old fractures.

PREOPERATIVE PROTOCOL

All the complex femoral shaft fractures were examined throughly to look for associated injuries, neurovascular damage.

Thorough examination of the ipsilateral hip and knee was performed.

All the fractures were stabilized initially with thomas spilnt, plaster immobilization and pin traction. All patients were stabilized hemodyanamically with intravenous fluids, blood transfusion as required.

Radiographic evaluation done by obtaining aneroposterior and lateral views of the femur, hip, knee as well as an anteroposterior view of the pelvis. The radiographs were critically evaluated to determine the associated comminution, presence of the air in the soft tissue and the amount of fracture shortening.

AGE DISTRIBUTION

<25 years	6
26-50 years	12
>51 years	2

Mean age was 34 years

SEX DISTRIBUTION

MALE	19
FEMALE	1
TOTAL	20

BONE GRAFTING

IL NAILING ALONE	14
IL NAILING AND BONE GRAFTING	6
TOTAL	20

SIDE INVOLVED

RIGHT	19
LEFT	1
TOTAL	20

MODE OF INJURY

RTA	15
FALL	5

DURATION OF HOSPITAL STAY

SHORTEST	6 DAYS
LONGEST	60 DAYS
MEAN	27 DAYS

OPERATIVE PROCEDURE

OPEN NAILING	19 CASES
CLOSED NAILING	1 CASE
TOTAL	20 CASES

All the cases were operated in the regular operating table with image intensifier.19 cases open nailing was done and for one case closed nailing was done. Proximal and distal locking was done with jig or with the help of c-arm.peroperative and post operative blood transfusion was done in all cases in relevant to blood loss.

POST OPERATIVE PROTOCOL

Drain removal on 48 hours.

Static quadriceps exercises were started after drain removal.

Early knee moblisation was encouraged after 48 hours as the patient tolerates pain.

Non weight bearing crutch walking was advised after suture removal.

Partial weight bearing was advised after 4 weeks.

Full weight bearing was advised after 12weeks.

All patients were followed regularly and clinical, radiographic evaluation was done to assess the fracture healing.Outcome was analysed with Thoresen. et al .criteria.

CLASSIFICATION-THORESEN et al (THORESEN B.O, ALHO A. JBJS 1985)[14]

Malalignment of femur	*excellent*	*good*	*fair*	*Poor*
Varus/valgus	5deg	5-9deg	10deg	>10deg
Ante/recurvatum	5deg	10deg	15deg	>15deg
Int/ext rotation	5deg	10deg	15deg	>15deg
Rom flexion knee	>130deg	120deg	90-119deg	<90deg
Shortening	1cm	2cm	3cm	>3cm
Ext deficit	5deg	10deg	15deg	>15deg

There should be no pain and tenderness in the fracture site.

A significant deformity is defined as limb shortening of more than 1cm,varus or valgus deformity more than 10 degrees, rotational malalignment more than 15 degrees.

ILLUSTRATED CASES

CASE I

HISTORY

40 years old male was admitted with alleged history RTA hit by a bus while riding a bicycle and sustained injury in the right thigh. No History of loss of consciousness, vomiting, ENT bleed. History of pain deformity in the right thigh.

CLINICAL EXAMINATION

Patient Concious, drowsy

Pulse rate : 108/mint

BP : 96/52 mmHg

Deformity, Abnormal mobility present in the right thigh. No distal neurovascular deficit.

INVESTIGATION

Radiology

X-ray right femur AP lateral

Segmental fracture P/3, M/3

Blood investigation

TC : 9000cells/mm^3

DC : P 64% L 34% E 2%

ESR : 5/10 mm/h

Hb : 9.2g%

Urea : 26mg%

Sugar : 102mg%

Creatinine : 1.0 mg%

Diagnosis

Closed segmental fracture shaft of the femur P/3, M/3

Procedure

Open intramedullary interlocking nailing done under SAB anaesthesia.

Size of the nail 400 x 9mm. Intraoperative blood loss 520ml.

2 units of blood transfused

Follow up done in 1 month and 4 months, 6 months.

Post operative complication : Nil

Functional results : Excellent

Analysis of the result done with Thoresen et al criteria

Shortening : Nil

Varus/Valgus Deformity : Nil

Rotational malalignment : Nil

Procurvatum/Recurvatum : Nil

Knee flexion : $0\text{-}140^0$

Hip flexion : $0\text{-}130^0$

CASE II

HISTORY

32 years old male was admitted with history of RTA hit by a lorry while driving a bike and sustained injury in the left thigh. No history of loss of consciousness, vomiting, ENT bleed. History of Pain, deformity in the left thigh.

CLINICAL EXAMINATION

Patietn conscious, oriented

Pulse rate : 102/mt

BP : 100/62

Deformity, abnormal mobility present in the left thigh. No distal neuro vascular deficit.

INVESTIGATION

Radiology

X-ray left femur AP lateral - spiral fracture of the shaft of the femur middle third.

X-ray chest PA : Normal

Blood investigation

T.C : 7600 cells / mm3

DC : P 64% L 30% E6%

Hb	:	10.2 g%
ESR	:	20mm/hr
Urea	:	32mg%
Sugar	:	102mg%
Creatinine	:	1.1mg%

PROCEDURE

Open intramedullary interlocking nailing done under SAB anaesthesia. Size of the nail 380 x 9mm. Intra operative blood loss 600ml. Two unit of blood was transfused.

Follow up

Patient was followed 1 month, 4 months, 8 months.

Post operative complication	:	Nil
Functional results	:	Excellent

Analysis of the result done with Thoresen et al criteria

Shortening	:	Nil
Varus/Valgus Deformity	:	Nil
Rotational malalignment	:	Nil
Procurvatum/Recurvatum	:	Nil
Knee flexion	:	$0\text{-}140^0$
Hip flexion	:	$0\text{-}100^0$

CASE III

HISTORY

33 years old male was admitted with history of hit by a lorry while driving a two wheeler and sustained injury in the right thigh, right knee, right leg. History of pain swelling, deformity in the right lower limb

CLINICAL EXAMINATION

Patient conscious, oriented

Pulse rate : 102/mt

BP : 90/62

Deformity, tenderness, abnormal mobility was present in the right thigh, right leg. No distal neuro vascular deficit.

INVESTIGATION

Radiology

X-ray right hip with femur AP - Segmental fracture shaft of femur middle third.

X-ray right knee AP and lateral – fracture tibial spine

X-ray right leg AP and lateral – Fracture both bone leg middle third.

DIAGNOSIS

Closed segmental fracture shaft of the femur middle third, fracture tibial spine, fracture both bone right leg middle third.

BLOOD INVESTIGATION

T.C : 7200 cells / mm3

DC : P 62% L 36% E2%

Hb : 10g%

ESR : 5/10mm/hr

Urea : 30mg%

Sugar : 100mg%

Creatinine : 1.0mg%

ECG, chest X-ray : Normal

Ultra sonogram abdomen : Normal

Initial treatment

Intravenous fluids, 2 units of blood transfusion. Fracture was immobilized with POP.

PROCEDURE

Closed intra medulary interlocking nailing

Size of the nail

Femur	:	380 x 9mm
Tibia	:	300 x 9mm
Blood loss	:	350ml
Post operative complication	:	Nil
Results	:	excellent

Follow up done 1 month, 2 months, 8 months.

Analysis of the result done with Thoresen et al criteria

Shortening	:	Nil
Varus/Valgus Deformity	:	Nil
Rotational malalignment	:	Nil
Procurvatum/Recurvatum	:	Nil
Knee flexion	:	$0\text{-}140^0$
Hip flexion	:	$0\text{-}140^0$

CASE IV

HISTORY

39 years old male has admitted with History of hit by a bus and sustained injury in the right thigh. No history of loss of consciousness, ENT bleed, vomiting.

CLINICAL EXAMINATION

Patient was conscious, drowsy. Pallor was present

Pulse rate : 114/mint

BP : 82/62mmHg

On examination swelling, deformity, abnormal mobility was present in the right thigh. No distal neurovascular deficit.

INVESTIGATION

Radiology

X-ray right hip with femur – AP

Segmental fracture of the shaft of femur middle third

Blood investigation

T.C : 6800 cells / mm3

DC : P 60% L 34% E6%

Hb : 8g%

ESR : 10/12mm/hr

Urea : 26mg%

Sugar : 92mg%

Creatinine : 1.1mg%

ECG, chest X-ray : Normal

Ultra sonogram abdomen : Normal

DIAGNOSIS

Closed segmental fracture shaft of femur middle third right.

Treatment

Patient was resuscitated with intravenous fluids, 2 units of blood.

PROCEDURE

Open reduction and internal fixation of fracture shaft of the femur was done with intra medullary interlocking nail. Intra operative blood loss 570ml. 2 units of blood was transfused.

Size of the nail : 380 x 9mm

Post operative complication : Nil

Follow up

Patient was followed 2 months, 8 months of post operative period.

Results : excellent

Analysis of the result done with Thoresen et al criteria

Shortening	:	Nil
Varus/Valgus Deformity	:	Nil
Rotational malalignment	:	Nil
Procurvatum/Recurvatum	:	Nil
Knee flexion	:	$0\text{-}140^0$
Hip flexion	:	$0\text{-}140^0$

OBSERVATION

1) 85% of the patients were in 26-50% of age.

2) Average age of incidence 34 years.

3) 95% of patients were male.

4) Right side involved predominantly in 90% cases.

5) Isolated femur fractures seen in 70% cases.

6) 75% of cases had high velocity injuries.

7) 55% of cases had segmental fractures of shaft of femur.

8) All cases were operated by open method except one patient.

9) One case of supracondylar fracture with segmental fracture shaft of the femur was treated by dynamic condylar screw fixation and interlocking nailing.

10) One case of undisplaced neck of femur fracture which was diagnosed late, and fixed with cancellous screws by mis a nail technique.

11) 20% of cases had associated fracture of both bone leg which were managed by inter locking nailing.

12) Mean duration between injury and surgery was 13days.

13) 25% of cases had primary bone grafting.

14) All cases treated by static interlocking nailing.

15) Reaming done in all cases.

16) Mean duration of fracture union for complex femoral fractures was 24 weeks.11 cases of segmental fracture united by mean duration of 29 weeks.

17) Mean duration of hospital stay 27 days.

18) 15% cases had limb shortening.

19) Average hip flexion 125^{o}.

20) Average knee flexion 120^{o}.

21) Average blood loss during the surgery is about 510 ml.

COMPLICATIONS

1) Two patients had infection in which one patient had delayed infection after the period of 1 year for whom implant exit was done after the fracture union.

2) Another patient had superficial infection to whom wound debridement and secondary suturing was done and patient had knee stiffness.

3) One patient had non union due to the malpositioning of distal locking screws and distal migration of the nail into the knee joint for which implant exit and internal fixation with locking compression plate osteosynthesis and cancellous bone grafting was done.

4) No implant failure was found in our series.

5) No neurovascular damage seen in our series.

RESULTS

All patients were followed by regularly and evaluated clinically and radiologically for fracture union and other complications.

1) Primary bony union : 18 cases.

2) Delayed union : 1 case

3) Non Union : 1case

4) Angulation : 3 cases

5) Malrotation : 1 cases

6) Knee Stiffness : 2 cases

7) Infection : 2 cases

8) Implant failure : nil

9) Duration of follow up : 6 months - 16 months (average 10 months)

10) Average amount of blood loss was 510ml.

11) Average operating time 125 minutes.

12) Average time for fracture union 26 weeks.

13) Average hip flexion 125^{o}.

14) Average knee flexion 120^{o}.

In 10 patients with excellent results there was no shortening, mal alignment, no pain or swelling in the fracture site and movements of hip, knee were near normal.

In 5 patients with good results had shortening of 1 cm and knee flexion of 120^{o}.

In 3 cases with fair results had limb shortening; and knee flexion of between 90^{0}-120^{0}.

In 2 cases of with poor results had limb shortening of 2 cm and knee stiffness. The range of movements of knee less than 90^{o}. All the patients had fractures of both bone leg and that could be the cause of knee stiffness.

THORESEN B.O ET AL CLASSIFICATION SYSTEM

Results	***In our study***	***Thoresen B.O. et al***
Excellent	10 (50%)	30 (64%)
Good	5(25%)	8 (17%)
Fair	3 (15%)	7 (15%)
Poor	2 (10%)	2 (4%)

DISCUSSION

Fractures of the shaft of femur usually a result of high energy trauma and accompanied by severe injuries to other organ system. The therapeutic goals in the treatment of this fracture are avoidance of cardiopulmonary problems, prevention of infection, early mobilization and functional rehabilitation of the limb. (B.O. Thoresen, Alho. A et al)[14] 1985.Complex femoral fractures are uncommon and usually caused by high energy violence. (Winquist and Hansen et al)[20]. 1984. Incidence is 1-5% of femoral shaft fractures. (Church J .C .T et al 1971. [21], Wu C. C ,Shih C.H et al 1993 et al). [22]

We considered fracture to be united when there is no tenderness or pain during weight bearing and when there is radiographically bridging callus with cortical density connecting three segments. (Wu.C.C, Wen .J.C. et al 1997.)[23]

Intramedullary interlocking nailing has proved to be the effective method in the treatment of the complex fracture shaft of femur in adults. Since the femur is surrounded by muscles and excellent soft tissue coverage, the destruction of endosteal blood supply due to reaming does not impede the fracture healing. Intramedullary interlocking nail acts as an internal splint and provide rigidity and rotational stability. (B.O. Thoresen , A .Alho et al) [14.] 1985.

PROBLEMS IN SEGMENTAL FRACTURES:-

Segmental fracture of femur is an unusual injury caused by a severe force and associated with marked damage to the soft tissue , especially quadriceps muscle. Since the patient who incur this type of fracture frequently have associated multiple injuries ,stabilization of patient is the first objective in treatment, but the two subsequent goals –bone union despite diminished vascularity and restoration of function despite excessive soft tissue damage. (Robert A Winquist , Washington .S. et al 1978)[24].In segmental fractures union of the distal segment is delayed in some cases.In our study one patient had delay in fracture healing in the distal fragment to whom bone grafting was done.

DYNAMIZATION Vs BONE GRAFTING:-

In segmental fractures there is always a substantial soft tissue injury. (Rinaldi E, Nurra A et al 1989).[25] The vascular supply of the distal segment is reduced in the segmental fractures. Therefore the healing of the distal fragment is usually slower .Weight bearing has been widely used to promote the fracture healing. Dynamization promotes union of fracture site in 50% of delayed union cases. Early bone grafting yield 100% fracture union (Wu CC.,. Wen- JC et al 1997).[23.] In our series three cases of segmental shaft of femur

were treated with primary bone grafting united in an average period of 26 weeks against 32 weeks in non bone grafted individuals.

Allogenic cacellous bone grafts can be used to augment the healing of fresh fractures associated with bone loss or non-union in conjuction with autologous bone graft. Osteogenic protein -1 can be used in recalcitrant non union.

PLATE Vs NAIL:-

The use of plate to achieve osteosynthesis of segmental fractures necesscitates a wide operative exposure and excessive stripping of soft tissues resulting in increased blood loss and long operating time. The risk of infection and delayed union is increased and failure of the plate is also common. Due to high rate of complications associated with this type of fixation, most of the traumatologists have advocated intramedullary interlocking nailing is the gold standard treatment. Early mobilization is thought to reduce the post operative complications, to maintain joint motion and to decrease the hospital stay.

FRACTURE TABLE Vs REGULAR OPERATING TABLE:-

All the cases patients are operated on standard radiolucent operating table using manual traction. The main advantage of this technique is that injuries of other extremities could be efficiently managed without the need for patient transfer.

Use of fracture table is associated with pudendal, sciatic, femoral nerve palsies due to traction or direct pressure. In addition compartment syndrome in well leg and crush syndromes have been documented with the use of fracture table and probably caused by intra operative positioning. (D.A. Weiss, WW. Brien 1990 et al)[26.]

In our series there was no neurovascular damage occurred during surgical procedure on radiolucent table. D.A. Weiss, WW. Brien et al 1990[26], study of interlocking nailing in segmental shaft of femur fractures in 33 patients they recorded two nerve palsies secondary to traction injury during intra medullary nailing in the fracture table, one each of the sciatic nerve and the pudendal nerve which were recovered completely within seven months.

OPEN Vs CLOSED NAILING :-

Our study consists of 19 cases of complex femoral fractures were treated by the open interlocking nailing and one case by

closed nailing. The mean duration between the injury and surgery is higher in our institution (average 17 days) due to patient reporting to our hospital after native treatment, non availability of operating room time due to long waiting list, and associated co-morbid conditions.

This longer duration between the time of injury and surgery is accounted for difficulty in fracture reduction with consequent opening of the fracture site. This time is higher against Thorsen. BO, Alho A. et al 1985.[14] series where it was 3 days and in Wu CC, Wen JC et al 1997 [23] study it was 1 day.

The patient who had close nailing, showed early fracture union in 20 weeks and functional outcome was excellent.

Static interlocking nailing was done in all 20 cases. Brumback R.J., Poka A. et al 1988.[27] concluded in their series that static locking of intramedullary nails in femoral shaft fractures does not inhibit the process of healing of fracture and routine conversion to dynamic intramedullary fixation although necessary need not performed always.

REAMING:-

In segmental fractures the danger of devitalization of the intermediate free fragment is lessened by mediculous soft tissue handling and avoidance of periosteal stripping. There is a theoretical risk of spinning of central fragment during reaming, there by damaging blood supply and delaying healing. Donald. A. Weiss. William. A. Brien et al 1990.[26] study shows strong attachment of soft tissues along the linea aspera prevents spinning in most of the cases. However, when the intermediate fragment is less than 10 cm length, spinning is a risk, and reaming should be done slowly and carefully.

The debris created during intramedullary reaming was shown to be collected at the fracture gap. This effect was also comparable with conventional bone grafting, thus supporting the theory of autografting. Reaming mobilizes cancellous bone inside the medullary canal. (Olerud R, stromberg L.et al 1986.) [28]

The reaming debris is a source of multipotent stem cells which can grow and proliferate and transform into various type of cells. In a quantitative assessment of growth factors in reamed aspirate, elevated levels of several growth factors were found in the debris as compared with bone graft from the iliac crest. The process

of reaming induced an increased of further growth factors by 111%.

In our series reaming was done in all cases and all fractures united with an average period of 26 weeks.

Average age of incidence is 34 years. This is comparable with Donald .A. Hansen T et al 1978.1. study in which it was 31 years. Average age of incidence in (Robert.A. Winquist. Washington 1978) et al.[20] study was 38 years, in Wu CC, Wen JC et al 1997 [23] study average age of incidence was 37 years.

60 percent of the fracture in our series located in middle third which is comparable which most of the studies.

15% of our patients suffered complex femoral fractures due to low energy injury which is comparable with Robert .A. Winqiust. Washington 1978 et al.[20] study and Wu CC, Wen JC et al 1997 [23] study and most of the patients were elderly individuals.

The younger patients with low energy injury, fracture united in an average period of 19 weeks. The older patient who had low energy injury, fracture united in an average period of 32 weeks. It may be due to co morbid conditions in the older age and delayed weight bearing.

BONE GRAFTING:-

Cancellous bone graft is usually harvested from iliac crest, distal radius, greater trochanter, proximal tibial and distal femoral metaphysis. (Goldberg V M, Steven S et al 1989) [29.] It is an excellent choice for the treatment of conditions that do not require structural integrity from bone graft.(Enneking W F, Moore J R et al.1990)[30].Cancellous bone graft has osteoconductive, osteoinductive potential.It contain osteoprogenitor cells.

Primary bone grafting was done in comminuted fractures. Three cases of segmental shaft of femur fractures treated with interlocking nail and bone grafting was united well in an average period of 24 weeks against the average of 32 weeks in non bone grafted individuals.

Three cases of comminuted fractures which were treated with interlocking nail and primary bone grafting united well in an average period of 21 weeks against 24 weeks

BLOOD LOSS:-

Average amount of intra operative blood loss in the segmental shaft of femur fractures in 580ml (range 450ml-800ml) which was higher in our study in comparision with D.A. Weiss WW.Brien et

al[26]. 1990. study in which it was about 470ml. It may be due to time delay for the operative procedure from the date of injury.

POST OPERATIVE INFECTION:-

In our series we had 2 cases of post operative infection one is superficial wound infection, which was treated with wound debridement and secondary suturing and wound healed well with secondary intention but the patient had knee stiffness. One case of late infection after the period of one year to whom implant exit done.

In D.A. Weiss,WW.Brien et al[26] 1990 and Wu CC, Wen JC et al 1997 [23] study they had no infection in 33 cases, 56 cases respectively. Winquist. RA. Hansen T [24] 1978. et al stated that open interlocking nailing involves the risk of infection. In our series we had two cases of post operative infection which may be due to open nailing.

MALUNION:-

15% of cases in our study had varus malalignment. All three cases are fracture involving the distal third fracture with comminution. In D.A. Weiss, WW. Brien et al[26] 1990 study 5%

cases had postoperative mal alignment. In Wu CC, Wen JC et al 1997 [23] study no cases of malalignment was reported.

Due to comminution and presence of wide medullary canal in the distal third femur could be the cause for varus deformity. It can be prevented by the use of poller screws, double distal locking, cylinder cast or cast bracing.

KNEE FUNCTION:-

In our study seventy five percent had knee flexion more than 120 degrees and had good functional outcome. Most of the cases operated earlier and post operative knee mobilization, quadriceps exercises started on second post operative period and had good results. 10% of cases had associated fracture both bone fracture and had poor knee flexion with average of 92 degree and these patients had poor fair results. In D.A. Weiss, WW Brien et al[26] 1990. study average knee flexion was 130 degree. In Winquist RA., Hansen. T 1978 [24] Study the average knee flexion was 135 degree which were higher than our study. Average knee flexion in our study was 120 degree. So, early stabilization of fractures and early rehabilitation yield excellent functional outcome.

A. Weiss., WW Brien et al[26] 1990 concluded that virtually all fracture distal to lesser trochonter can be nailed regardless of pattern of fracture and degree of comminution. This supports the role of stable fixation in facilitating union in complex femoral fractures.

CONCLUSION

Our study consists mostly of male patients in their active part of their life. So, there is a need for quick return of their daily routines. Intramedullary interlocking nailing for complex femoral fractures has been established world wide as the gold standard treatment because of its load sharing property, internal splinting, and rotational stability. These contribute the stable osteosynthesis.

When the patients are taken up for surgery earlier, fracture reduction can be achieved by closed method and yield early fracture union, excellent functional outcome and prevention of complications.

Early mobility, a low rate of complications and high incidence of union obtained in this study in majority of patients makes this technique more reliable.

BIBLIOGRAPHY

1. Robert A, Hansen .T. segmental fracture s of shaft of femur treated by closed intramedullary nailing. T.JBJS Vol 60A 934-939. Oct 1978.

2. Funk.J, wells .R supplementary fixation femoral fractures.Clin.ortho. 60; 4-49.1968.

3. Kuncher, Gerhard. Practice of intramedullary nailing Springfield Illinois, Charles C Thomas 1967.

4. Klem KW. , Boren M. interloking nailing of femur and tibia. Clin ortho. 1986; 212 89-100.

5. Human anatomy B D. Chaurasia 4th edition vol 2, 16-22.

6. Barei BD., schildhauer.T.K, Nork .SUE .Noncontiguous fracture of femoral neck, femoral shaft, and distal femur. J. Trauma, 2003 .55(1) 80-86.

7. Butler MS. Brumbark RJ. Ellison TS. Interlocking nailing for ipsilateral fractures of femoral shaft and distal femur.

8. J, Neufield A.J. Mays J. Skeletal traction methods. Clin ortho. 1974; 102; 144-151.

9. Sharma JC, Gupta SP, Mathur NC, Comminuted femoral shaft fractures. Treatment by closed intramedullary nailing and functional cast bracing. J,. Truama 1993; 34(6), 786-791.

10. Connolly JF, Dehne E, Lafollette B. closed reduction and early cast brace ambulation in the treatment of femoral fractures. JBJS, 1973; 55(8). 1581-1599.

11. Monnay V, Nckel VL, Harrey JP. Cast brace treatment for fracture of distal part of femur. JBJS -1970 52(8), 1563-1578.

12. Martinus B, Terje T. torsional deformity after intramedullary nailing of femoral shaft fractures. JBJS 1993; 75 B ; 799-803.

13. H.C Pape. , Grannooudis P. the biological and physiological effects of femur. JBJS 2007 89-B; 1421-1426.

14. Thoresen BO, Alho A., intramedullary interlocking nailing nailing in femoral shaft fractures A report of fourty cases. JBJS 1985; 67; 1313-1320.

15. Alonso J, Glisslee. W, Hughes JL. External fixation of femoral shaft fractures. Clin. Ortho 1989; 241- 83-88.

16. Turen CH., Brumbark RJ. conversion of external fixation to intramedullary nailing for fracture of shaft of femur in multiple injured patients . JBJS. 2000. 82(6) 781-788.

17. Robert S., Ganz R. The evolution of femoral shaft plating technique. Clin ortho 1998; 86-4; 326-336.

18. Gates DJ, Alms M .hinged cast and roller traction for femoral fractures. JBJS .1985, 67-5; 750-756.

19. Alho A. concurrent ipsilateral fractures of the hip and shaft of femur. Ann chir gyaecol 1997; 86-4; 326-336.

20. Winquist RA, Hansen S. closed intramedullary nailing of femoral fractures. A report of 520 cases. JBJS 66-A 529-539.1984.

21. Church JCt.Segmental fractures of femure, JBJS 1971; 53(2): 355.

22. Wu CC, shin CH, Ueng WN. Treatment of segmental femoral shaft fractures. Clin Orthop 1993; 287; 224-30.

23. Wu CC, Wen JC et al. Healing of 56f segmental femoral shaft fractures after locked nailing. Acta Orthop Scand 1997; 68m(6): 537-540.

24. Robert A, Washington S.Segmental fractures of femur treated by closed intremedullary nailing JBJS, 1974, 72: 534-554.

25. Rinaldi E, Nurra A.Mulfifocal fractures of the femur, Ital of Orthop Traumatol 1989; 15 (4): 409-414.

26. Wiss DA, Brien WW, Stentson WB, JBJS 1990; 72: 724-728.

27. Brumback RJ, Lakatos RP, POka A.Bathon GH, Burgess AR intramedullary nailing of femoral shaft fractures. Fracture healing with static interlocking fixation. JBJS 1988; 70 (10): 1453-62.

28. Olerud S.Stromberg. L Intramedullary reaming and mailing its early effects on cortical bone vascularization. Orthopedics 1986; 9 (9): 1204-1208.

29. Goldberg VM, Sreven S.The biology of bone graft repair. Semin Arthroplasty, 1989; 7:12.

30. Enneking WF, Moore JR, Burcherdt H, Physical and biological repair in cortical bone transplants. JBJS - 1990; 57: 237-252.

S. No.	Age & Gender	Mode of Injury	Open / Closed	Side	AO Type	Duration between Injury and Nailing	D.O.S	Bone Graft +/-	Duration of Hospital Stay (Days	Associated Injuries	Infection +/-		MALALIGNMENT			Shortening (cms)	Rom Knee Flexion	Hip flexion	Final Results
												Radiological union (weeks)	Varus /Valgus	IR/ER	Pro/recurvatum				
1	30/M	RTA	Closed	R	C2	2Days	26.07.07	-	6days	#BB R leg, #tibial spine Rt	-	20	-	-	-	-	$0\text{-}140^0$	$0\text{-}140^0$	excellent
2	18/M	RTA	closed	R	C1	17 Days	07.09.07	-	30days	-	+	24	-	-	-	0.5cm	$0\text{-}120^0$	$0\text{-}140^0$	good
3	47/M	Fall From Height	Closed	R	C1	14 Days	22.10.07	-	26 Days	-	-	17	-	-	-	-	$0\text{-}130^0$	$0\text{-}140^0$	excellent
4	38/M	RTA	Closed	L	C2	15 Days	22.11..07	-	25Days	-	-	26	-	-	-	1cm	$0\text{-}140^0$	$0\text{-}100^0$	excellent
5	24/M	RTA	Closed	R	C2	10Days	22.01.08	-	25Days	-	-	29	–	-	-	-	$0\text{-}120^0$	$0\text{-}100^0$	good
6	27/M	RTA	Closed	R	C1	30days	28.01.08	+	37days	#BB leg L	-	21	-	-	-	–	$0\text{-}140^0$	$0\text{-}120^0$	excellent
7	24/M	Fall From Height	Closed	R	C2	11 Days	24.01.08	+	24 Days	-	-	38	10^0	-	-	1cm	$0\text{-}90^0$	$0\text{-}100^0$	fair
8	78/F	Fall from height	Closed	R	C1	16 Days	14.02.08	-	28days	-	-	32	-	-	-	-	$0\text{-}120^0$	$0\text{-}100^0$	good
9	53/M	Fall From Height	Closed	R	C1	8 Days	17.02.08	-	14 Days	-	-	24	-	-		-	$0\text{-}120^0$	$0\text{-}120^0$	good
10	32/M	RTA	Closed	L	C1	12 days	22.02.08	-	26days	-	-	28	-	-	-	-	$0\text{-}140^0$	$0\text{-}100^0$	excellent
11	27/M	RTA	Closed	R	C1	10days	27.02.08	+	19days	-	-	24	-	-	--	-	$0\text{-}140^0$	$0\text{-}120^0$	excellent
12	45/M	RTA	Closed	R	C2	5 Days	10.03.08	+	15 days	-	-	24	-	-	-	1cm	$0\text{-}100^0$	$0\text{-}110^0$	fair

13	39/M	RTA	Closed	R	C2	30 Days	14.03.08	-	45 Days	-	-	30	-		-	1cm	$0\text{-}140^0$	$0\text{-}140^0$	excellent
14	29/M	RTA	closed	R	C1	28 Days	24.03.08	-	60days	-	-	Not united	15^0	10^0	-	2.5cm	$0\text{-}70^0$	$0\text{-}100^0$	poor
15	38/M	RTA	Closed	R	C_2	19 Days	05.04.08	-	35 Days	# BB leg R', sc# R femur	-	30	10^0	5^0	-	2.5cm	$0\text{-}90^0$	$0\text{-}120^0$	fair
16	22/M	RTA	Closed	R	C_2	1 Day	06.04.08	-	7 Days	-	-	28	-	-	-	–	$0\text{-}130^0$	$0\text{-}130^0$	excellent
17	18/M	RTA	Closed	R	C_2	13 Days	09.04.08	+	26 Days	-	-	28	-	-	-	1cm	$0\text{-}130^0$	$0\text{-}130^0$	excellent
18	25/M	RTA	Closed	R	C2	26 Days	28.04.08	-	38 Days	#BB Leg ®	+	30	-	15^0	-	2cm	$0\text{-}80^0$	$0\text{-}100^0$	Poor
19	46/M	RTA	Closed	R	C1	19 Days	12.05.08	-	30 Days	#neck of femur	-	24	-	-	-	-	$0\text{-}120^0$	$0\text{-}110^0$	good
20	30/M	RTA	Closed	R	C_2	7Days	18.05.08	+	27Days	-	-	26	-	-	-	-	$0\text{-}140^0$	$0\text{-}130^0$	excellent

CASE – I

PRE OP AP VIEW

1 MONTH FOLLOW UP (AP VIEW)

AP VIEW-4 MONTHS FOLLOW UP

AP VIEW-6 MONTHS FOLLOW UP

CLINICAL RESULTS ON 6 MONTHS FOLLOW UP

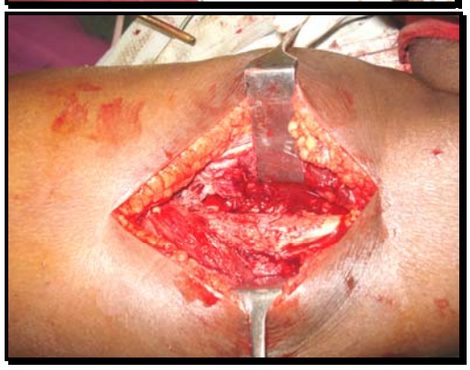
CASE – II

PRE OP AP UP

3 MONTHS FOLLOW UP

9 MONTHS FOLLOW

PER OPERATIVE



CLINICAL FOLLOW UP

CASE – III

PRE OP (AP, LATERAL)

2 MONTHS FOLLOW UP (AP VIEW, LATERAL VIEW)

8 MONTHS FOLLOW UP (AP, LATERAL)

CASE – IV

PRE OP (AP VIEW)

2 MONTHS FOLLOW UP (AP VIEW)

8 MONTHS FOLLOW UP (AP VIEW)

CLINICAL FOLLOW UP



PER OP PICTURE